Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

phenomena are essentially different. They are not to be confounded with the aerolites, for these, as far as their motions have been calculated, have been found to have a relative velocity too small to carry them beyond the earth's sphere of attraction, so that they may either be terrestrial satellites, or the products of a lunar volcano. They must also be distinguished from the *aurora borealis* ; which affects the magnetic needle, has the magnetic pole for its radiant, is seen as often at one season as at another, and has a different character of periodicity ; for Mairan has shown, that, after being frequently seen for several successive years, it disappears for a long period. Quetelet and others have, however, thought that these phenomena are connected together, and with storms, earthquakes, &c. But the links or laws of connexion have in no case been discovered, and Quetelet is undoubtedly pursuing the only path which can ever lead to their discovery, that of careful inductive observation. Much time has been wasted in useless speculation, and in vain attempts at solving the obscure problems here involved, by some less wearisome process than that of laborious research. But the Gordian knot can only be cut by the sword of an Alexander ; and the rewards of genius are inexorably denied to the impatient and superficial guesser.

ART. VIII. — 1. *Final Report on the Geology of Massachusetts.* By EDWARD HITCHCOCK, LL. D., Professor of Chemistry and Natural History in Amherst College, Geologist to the State of Massachusetts, etc. Amherst : J. S. & C. Adams. Two Volumes. 4to. pp. 831. Plates 55.

2. *Elementary Geology.* By EDWARD HITCHCOCK, LL. D. Third Edition, revised and improved. With an Introductory Notice, by JOHN PYE SMITH, D. D. New York. 8vo. pp. 348.

THE honor of the first movement in the great work of Geological Surveys in the United States belongs to North Carolina. In 1823, at the suggestion of Professor Olmsted, the legislature of that State commissioned him to execute a

Geological Survey. His report was restricted to Economical Geology, and was published, in two parts, in 1824 and 1825. In the following year, South Carolina gave a similar commission to Professor Vanuxem, whose report was published in the newspapers. In 1828, in a review of Professor Olmsted's report, Professor Hitchcock invited the attention of other legislatures to this subject. The survey of North Carolina, he remarked, —

> "was attended with great success, and certainly confers much honor upon its projector, and upon the intelligent representatives who provided the means of carrying it into execution. It is a good example, therefore, to hold up before other legislatures, to induce them to adopt a similar course. What an accession would be made to our resources and to a knowledge of our country, were a thorough examination to be instituted into our mineralogical, geological, and even botanical riches! How worthy the genius of our government to have an accurate geological map, with an accompanying report, accessible to all our citizens!" — *American Journal of Science*, Vol. XIV. p. 230.

The example, however, of the Carolinas seemed to be forgotten, and a plan had been matured for a convention of scientific men from various parts of New England, to consider this subject and petition the legislatures. But in the spring of 1830, the legislature of Massachusetts ordered a trigonometrical survey of the State, with a view to the construction of a map; and, at the suggestion of Professor Hitchcock, Governor Lincoln recommended to the legislature to connect with it a Geological Survey, which was accordingly ordered. The surveyor received his commission, and immediately entered upon the work. Enthusiasm in the pursuit of this science had not suffered him to remain idle in previous years, and the fruits of his former labors were immediately available, and constituted no inconsiderable portion of the report made in 1833. In 1832, the first report, which was little more than a preliminary survey, was published in a pamphlet of seventy pages. In 1833, a full and, as was then supposed, a final report was published in an octavo volume of seven hundred and two pages, with a geological map and an atlas of plates. A second edition was printed in the following year. To this report were appended catalogues, formed by several zoölogists, of the animals of the State, and, by the Geological Surveyor, of the native plants. For an account of this valuable work we refer our readers to a former volume of this Review.*

Although a great number of facts had been collected and arranged, and had led to many important and interesting inferences, it soon appeared, from the discovery of fossil footmarks and of many other new phenomena, that Professor Hitchcock had only commenced the work. In 1836, however, he was persuaded to undertake the survey of the Eastern District of New York. Fortunately for Massachusetts, an ardent desire to continue the exploration of his native State, and feeble health, induced him to send in his resignation. Near the close of 1836, Professor Hitchcock addressed a letter to Governor Everett, urging the importance of further researches in the Geology of the State, and recommending that the departments of Zoölogy and Botany should be committed to the Boston Society of Natural History. This plan was adopted by the legislature, and a new survey was commenced in 1837.

In 1838, a pamphlet on the Economical Geology of the State was published, which, like the first, was intended merely as a *reconnaissance*. During four years, the Geological Survey was carried on with an industry and perseverance which knew no limits, and the materials were collected for the "Final Report." After some unavoidable delay in printing, this at length appeared in the noble quarto volumes which are now before us. It is much to the credit of Massachusetts, that this work, the fruit of the enlightened views of her legislature, and of the efficiency of her executive, has been given to the public in a form worthy of its contents. The volumes relating to the "Natural History of New York" are published in a style equally rich, and it is to be hoped that other States, also, will follow the example, in this respect, of New York and Massachusetts. With greater pecuniary resources, the number of pictorial illustrations, to use a current phrase, might probably have been increased; but, in times of so much zeal for public economy, we could not have expected more. It is a curious circumstance, that one of the principal objects originally contemplated in this undertaking, the coloring of the geological formations on the map to be executed by the Trigonometrical

---

* See *North American Review*, Vol. XLII. p. 422.

Survey, has not been accomplished, for the obvious reason, that this map is not yet completed.

It will be seen, from some prefatory remarks of the author, that the "Final Report" is not merely a third edition of the first, as may have been anticipated, and as has been inadvertently remarked by the editors of a scientific journal. Even if the work had been enlarged only by some additional observations on subjects previously investigated, the appropriation for a new survey would have been profitably expended. The constitution of soils, and the means of their improvement, which were scarcely noticed in the "First Report," occupy upwards of one hundred pages. We have the results of four hundred analyses, each of which was performed three times, an amount of labor which the chemist only can appreciate. The curious subject of claystones is enriched by the addition of many facts, and has so outgrown the space allotted to it in the first edition as to be scarcely recognizable. Not to mention a great number of discoveries which have been made in the new survey, and which have rendered it necessary to rewrite nearly the whole work, the subject of "Ichnolithology," occupying sixty quarto pages and twenty-two plates, is entirely new, and we may safely affirm, that facts are related of greater interest, respecting this subject, than can be found in any other geological treatise.

The "Final Report" consists of four parts; namely, Economical, Scenographical, Scientific, and Elementary Geology. More than half of the first part is devoted to the soils of Massachusetts, and forms a very valuable contribution to a branch of agricultural science which is yet in its infancy. The old method, of ascertaining merely the amount of organic matter in a soil, is justly regarded as of little practical utility. It is well known, that some soils, such as peat meadows, which contain a large quantity of organic matter, possess comparatively little fertility. The agriculturist, therefore, reasonably inquires, in what condition are the organic constituents of his soil. As the *spongelets*, through which, on the principle of *endosmosis*, the roots of plants receive nourishment from the soil, are permeated by liquid matter only, the first and most important step is taken, when the soluble and insoluble portions of decomposed organic matter are separately ascertained. This has been done in the analysis of specimens of one hundred and forty-six soils.

It is well known to those who have been watching the progress of organic chemistry, in its application to agriculture, that the attempt to advance beyond this first step, and to investigate the chemical constituents of the organic matter in soils, has been attended with no small difficulty, and very different views on this subject are entertained among eminent chemists. Unfortunately, the real difficulties in the case have been increased by a misunderstanding in the use of terms. The word "geine" has been the source of so much difficulty, from the different senses in which it has been used, that we should gladly see it expunged from the vocabulary of the chemist. Professor Hitchcock, wisely defining the use which he makes of this word, employs it in a comprehensive and popular sense, as denoting all the decomposed organic matter of soils. As our author is uniform in his use of the word, we shall not stop to inquire in what sense it was used by Berzelius. We do not by any means intend to assert, that geine, in the sense in which it is here used, denotes a proper chemical substance. While, together with the valuable suggestions of Dr. S. L. Dana, our author has given us the important results of his own analyses of soluble and insoluble geine, Dr. C. T. Jackson has satisfactorily proved that it is not a chemical substance, and has obtained from it crenic and apocrenic acids, and with these acids he has formed various salts. This distinguished analyst has also detected the existence of these acids in plants. The details of these and numerous other important researches of a similar character, which Dr. Jackson has been for several years accumulating, when published, will throw much light on a very difficult and intricate subject. In the *Rapport Annuel sur les Progrès de la Chimie* for 1841, by Berzelius, made to the Royal Academy of Stockholm, our readers may find a comprehensive view of the researches of Niulder on the constitution and properties of the non-nitrogenous constituents of the organic matter in soils, which are much more numerous than those that contain nitrogen. The latter class, indeed, embraces only the two acids above mentioned.

Professor Hitchcock has shown by his analyses, that all our soils contain phosphates, and he infers, from the examination of a portion of them for phosphate of lime, that this salt is invariably present. Other chemists have come to the same conclusion in respect to soils generally. This result was anticipated from the fact, that, in many esculent plants, especially in Indian corn, this substance exists in large quantities ; and, since the bones of all vertebrated animals are in a great measure constituted of the same salt, it requires not much prophetic skill to foresee its discovery in the food of every species of these animals.

The remarkable fact is shown by the analyses of Professor Hitchcock, that, with a few exceptions, the soils of the State are entirely destitute of carbonate of lime. On the other hand, it appears that sulphate of lime is almost universally present. The judicious application of these salts is explained and enforced. The analyses of our author also prove, that the fertility of soils does not depend entirely upon the quantity which they contain of the above-named salts and of organic matter. Other circumstances, such as the state of mechanical division, and the power of absorbing and retaining moisture, have an important influence. The details of numerous experiments, on the absorbing and retaining properties of soils, are given in a table.

The general conclusions of a practical nature at which the author arrives, from the consideration of this subject, are the following.

> "First : there is, in general, too small a supply of calcareous matter in our soils ; that is, of lime.
>
> "The second great desideratum is an additional supply of geine, or the food of plants.
>
> "Hence, thirdly, the great object of the agricultural chemist should be, to discover new supplies of both these substances ; and suggest means for their proper and successful application by the farmer." — p. 67.

Accordingly, Professor Hitchcock gave particular attention to the discovery of deposits of these substances. Eleven beds of marl are described, and the results of their analyses exhibited. Directions are also given for their use. After describing some other calcareous deposits, our author presents his readers with an account of the limestones of the State, in their relations to agriculture. Another interesting result of the new survey is the discovery of an extensive deposit of green sand, in Duxbury and Marshfield. It differs essentially from that of New Jersey, in the almost entire absence of potassa, but contains a large per-centage of protoxide of iron, from the presence of which, its utility as a fertilizing agent is rendered probable. The natural sources of vegetable nutriment in peat swamps, marsh mud, and muck sand, and the manner of using them, are pointed out.

The use of muck sand, often called quicksand, is a novelty in agriculture. On the subject of fossil fuel, the most interesting facts have been discovered since the publication of the First Report. The favorable location of the anthracite of Mansfield, near the junction of the railroads which connect Boston, Providence, Taunton, and New Bedford, as well as the number and thickness of the beds of coal, justly excited high expectations in the companies which so successfully commenced their explorations. Whenever a more prosperous time for the capitalists shall admit of the heavy investment which is necessary in the first stages of such an enterprise, there is good reason to hope that the State will no longer be compelled to send abroad annually the amount of two and a half millions of dollars to purchase fuel.

Under the head of "rocks useful for architectural and ornamental purposes," several discoveries have been made since the publication of the Report of 1833. A peculiar variety of soapstone has been found in Andover, which, on account of its hardness, may be used in external architecture. The inexhaustible quantity of the serpentine of Lynnfield, its vicinity to Salem and Boston, and the facility with which it may be wrought, must eventually render it of great value. The importance of the most economical methods of burning lime is duly appreciated by our author. Various modes of doing it are described, and illustrated with plates. It is a curious fact, which is one of the innumerable illustrations of the value and the deficiency of geological information in the community, that, in most of the towns in Berkshire county which have been most noted for burning lime, "no ledges of limestone occur ; but dependence has been placed entirely on the loose blocks that diluvial action has driven thither from the neighbouring towns. And I have been assured, that the inhabitants of some towns, which are based upon good limestone, transport most of the lime that they use from quarries in towns where very little exists in ledges, under an idea that they have no limestone where they live that is worth burning."

The Second Part, or Scenographical Geology, has been enriched by the addition of a great number of wood-cuts and plates, from drawings which were gratuitously furnished by several artists. Many new and remarkable features in the striking scenery of Berkshire county are described in a manner which is itself a practical illustration of the intimate connexion between geological pursuits and the love of the beautiful and sublime in nature. We find the following description of a projecting precipice on Mount Washington, near the western line of the State.

> "Let the observer either follow back the rough path he has just trodden on the south side of the stream, or follow, by a circuitous route, the north bank, until he reaches the spot above the upper falls, where he first entered the gorge, and there he will find a steep footpath, which will conduct him to the top of the precipice that overhangs these falls. This is mostly covered by bushes; yet in one place he can advance to its very edge, and, as the edge projects upwards a little, it is well adapted to prevent one from falling over. On letting down a stone from this spot, with a string attached, I found that it required a length of 194 feet before the water was reached. I have scarcely ever felt such a creeping and shrinking of the nerves, and disposition to draw back, as here. Even though I took hold of bushes with both hands, I could not comfortably keep my eyes turned long into the frightful and yawning gulf; for it seemed as if it needed only a stamp of the foot, or perchance only my weight, to cause the rock on which I stood to follow the example of multitudes of the same kind that were strewed at its base." — p. 292.

Part Third, or Scientific Geology, is the most voluminous, occupying 414 pages. We can glance only at a few of the more interesting subjects which have been developed since the publication of the First Report. Following the same order, in the description of the formations, which was noticed on a former occasion, our author commences at the surface with alluvial deposits and agencies.

For one of the most remarkable of the recent discoveries in Palæontology we are indebted to the celebrated Prussian zoölogist, Ehrenberg, who has shown, that some alluvial deposits, as well as extensive strata in the older formations, are composed of the shields, or flint-shells, of fossil animalcules. Professor Bailey, of West Point, was the first in this country to detect these microscopic remains, and his subsequent researches on living and fossil infusoria are replete with interest.

> "How very singular," says Professor Hitchcock, "that animals so very minute should perform so important an office in the geological changes that are taking place on the globe! Here we have deposites several feet thick, extending over hundreds of acres, made up entirely of the remains of animals, of which hundreds of thousands are requisite to form a single cubic inch! We have long been accustomed to admire the process by which the minute polyparia rear the extensive structures, known by the name of coral reefs, stretching over hundreds of leagues in the tropical seas. But now we find, that, within our own observation, we may see effects no less marvellous, produced by animals of a still more diminutive size, — too small, indeed, to be discovered by the naked eye." — pp. 310, 311.

These deposits are of a grayish white color, and are almost impalpable, like magnesia. One of the most extensive is in Andover, and is seventeen feet thick, and covers an area of six acres. Professor Hitchcock has inserted a valuable communication from Professor Bailey, in which are described five genera and numerous species of these curious relics of ancient animalcules.

In the next formation, diluvium or drift, a great number of interesting facts were described in the First Report, and the additional facts here presented do not lead to any farther generalization. But the numerous theories which have been offered by various writers, in order to settle the vexed question of the origin of drift, have rendered it expedient to enlarge and modify the theoretical remarks. For many years, Professor Hitchcock labored almost alone in this very difficult department of Geology, while others had given so little attention to many of the leading facts, that they supposed the phenomena in question to be chiefly the fruit of a strong imagination. Hence, the details which were given in the Report of 1833, and which the author had been accumulating for ten years, were obviously described with little reference to other geological works. It was not then known in this country, that the rounded hills and excavations of drift, which the admirers of the *Études sur les Glaciers* now call *moraines*, and the diluvial furrows on the surface of rocks, existed in Europe to any considerable extent. Accordingly, we find Professor Hitchcock, in 1835, using the following language ; " But so far as I can judge, from the accounts which European Geologists have given us of diluvial action in that quarter of the globe, I doubt exceedingly whether it has left traces by any means as striking as in this country." " Such language implies that these traces are by no means common, as in this country." Very recently, however, European Geologists have given to this long neglected formation that attention which its peculiar difficulties require. But it is not a little remarkable, that, in their allusions to the kindred facts observed in this country, they represent them as *recently* discovered, although ten years had elapsed since Professor Hitchcock described and figured them. Whatever opinions may be entertained respecting the hypothetical views of our author, it is quite too late to deny him the merit of having first thoroughly explored this difficult subject.

In the First Report, we find our author maintaining that the accumulations of drift could not have been the product of any transient deluge, but that they were the result of various agencies operating through indefinite periods of time, and that they were finally " modified by a powerful deluge, sweeping from the north and northwest over every part of the State, not excepting the highest mountains." It was conjectured, that " this deluge might have been produced by the elevation of an extensive portion of the bottom of the arctic ocean." But whatever may have been the primary causes of diluvial action, the following inferences, in the Final Report, are considered as legitimate.

"1. The highest parts of New England, and in fact all the northern parts of our continent, have been swept over by a powerful current from the northwest to the southeast." " In Massachusetts, we have Mount Everett, not less than two thousand six hundred feet high, and Wachusett, three thousand feet high, and, in New Hampshire, Monadnoc, three thousand two hundred and fifty feet high, all bearing marks of powerful erosion, and all of them standing as insulated peaks, hundreds of feet above the surrounding country ; and, in Maine, Dr. C. T. Jackson describes Mount Ktaadin as showing diluvial action on its summit, which is five thousand three hundred feet above the ocean."

In the third edition of the Elementary Geology, Professor

Hitchcock gives the result of a recent visit to the White Mountains, with a figure of the rounded and water-worn rocks on Mount Washington, which are found at the height of five thousand feet. This is the highest part of the mountain on which any rock is found *in situ.*

"2. The diluvial waters must have been oceanic. What other aqueous agency could have produced a current two thousand miles in width, I am unable to conceive." [For we are told that it has swept over the whole country from Nova Scotia to Missouri, and over the tops of the highest mountains.]

"3. There is no reason to suppose that the inequalities of surface, which now exist, were essentially different at the epoch of diluvial action. Minor changes were, indeed, produced by that action, as well as by subsequent alluvial agency. But the great outlines remain unchanged. For we find the bowlders to have been obstructed just as they would have been, if the present mountains then existed; and, in some cases, the current was deflected just as it would be now. But the fact that has struck me as most decisive is this: Where large surfaces, often several square rods, and sometimes many acres, are smoothed and scratched, I have never seen any evidence of a change in the relative levels of different portions of that surface.

"4. Diluvial action in New England appears not to have taken place, till the continent had been raised nearly to its present height above the ocean. The counter supposition is, that it took place when the present surface formed the bed of the ocean, or was gradually rising above it."

But our limits will not permit us to transcribe the forcible arguments by which our author maintains his position, and overthrows the opposing theory.

"5. It is difficult to explain all the phenomena of diluvial action, without calling in the aid of icebergs, or some other agent, by which masses of rock could be floated along the surface of the waters; yet, after all, those icebergs will explain but a small part of the effects of this action.

"6. The phenomena of diluvial action in this country far transcend the effects of any agencies now operating, without admitting a great increase of intensity in their action." — pp. 397 - 401.

After these well-sustained inferences, our author very cautiously embarks on the ocean of hypothesis, in order to discover the cause of diluvial action. Several hypotheses, among them the now celebrated glacial theory of Agassiz, are examined and rejected. The theory to which preference is given is the following; "That an extensive elevation of the bottom of the Arctic Ocean threw its waters, loaded with ice and detritus, southerly, over the American and also the Eastern continent. It supposes that there may have been a succession of elevatory movements." Against this hypothesis, however, Professor Hitchcock urges some serious objections, and remarks, "To my mind, therefore, no theory of diluvial action, hitherto proposed, is so free from objections that I feel satisfied with it." "I do not feel prepared to propose any regular theory of this agency, in which I place much confidence."

During the long period which elapsed while the Final Report was in press, a copy of the *Études sur les Glaciers*, by Agassiz, found its way to New Haven, and our author, with his usual zeal, went to that place to become better acquainted with its contents. The result is given at length in a postscript, which contains his views, as they were presented in his Address at Philadelphia, in April, 1841, before the Association of American Geologists. The first impressions of Professor Hitchcock, in favor of the theory of Agassiz, were certainly very sanguine. "Henceforth glacial action must form an important chapter in geology. While reading this work, and the abstracts of some papers by Agassiz, Buckland, and Lyell, on the evidence of ancient glaciers in Scotland and England, I seemed to be acquiring a new geological sense."

It is obvious, however, as we proceed, that even under the strong impulse of these first impressions, our author could not adopt this theory without important modifications; for, after stating with his usual candor the arguments for and against it, he concludes his examination of this theory with the following remarks. "But I can hardly doubt that *glacio-aqueous* action has been the controlling power in producing the phenomena of drift. Having hovered so long over the shoreless and troubled ocean of uncertainty and doubt, I may be too ready to alight on what looks like *terra firma*. But, should it prove a Delos, I have only to plume my wings again, when it sinks beneath the waves."

The darkness which formerly brooded over this difficult subject, and the illustrious name of Agassiz, conspired to gain for the glacial theory an enthusiastic reception from many eminent geologists, which, under other circumstances, it would not have obtained. It is, therefore, certainly no more than justice to the opinions of Professor Hitchcock, that they should be inferred from his impartial examination of this theory as a whole, and from his concluding remarks, rather than from the general and complimentary expressions with which the theory is introduced. Thus understood, his Address harmonizes with his remarks published, at nearly the same time, in the second edition of the Elementary Geology.

Professor Hitchcock had formerly described certain beds of clay as a deposit of the "Newest Tertiary." But, within a few years, numerous instances have been found in which this clay overlies, or is "interstratified" with, drift. Our author, therefore, calls it diluvial clay, and says, that "whenever valleys of any considerable extent existed in the State at the period of diluvial action, and these were cut off from the ocean by some barrier, I find this clay and sand." It is supposed, that the deposition took place during the subsequent gradual drainage of the waters.

The most remarkable circumstance connected with diluvial clay is the existence of the "clay-stones," which are found in it. One of the most common forms of these singular concretions is that of a sphere, much flattened, and resembling a coin with the edges rounded. Similar concretions have been observed, although but in few localities, in Europe, and their nature does not appear to be generally understood. We are informed in a note, that a specimen from the Kimmeridge clay was forwarded to Professor Hitchcock by an able English geologist, with this label; "Kimmeridge coal money, (use and age unknown,) found abundantly in the Kimmeridge clay, Dorset coast." On the authority of Mr. Frederick Tamnau, Jr., a distinguished Prussian mineralogist, we are informed, that, in Sweden, the scientific men believe these clay-stones to be the remains of some kind of Mollusca. Mr. Tamnau is of opinion, that they are concretions, like those of Massachusetts, and Professor Hitchcock pronounces the specimens received from Nykoping to be "precisely like the clay-stones of Massachusetts." The original researches, therefore, of our author on this subject, showing the chemical constitution of these concretions, their six predominant types of form, of which the modifications are innumerable, and their other physical characters, are both valuable and well-timed. His conclusions are, "that these concretions were formed by the accretion of carbonate of lime around certain centres of attraction in the clay; which, although pervious to the solution of cementing matter, does not appear to have been removed from its original position"; that, "if we conceive of modifications in the form and consistency of the clay, and the carbonate of lime in solution, we can give a probable explanation of the varieties of form"; and "that these concretions are produced by laws as definite as those of crystallography." Not the least striking feature in the appearance of many of the clay-stones is their rude and burlesque resemblance of certain animals or artificial objects, some having the outline of various birds, quadrupeds, and reptiles, and others, of Pagan images, spectacles, teapot covers, and broad-brimmed hats.

Passing by many subjects, which are not entirely new to the Final Report, we come to the most important of Professor Hitchcock's numerous discoveries in geology, — the fossil foot-marks in the new red sandstone of the Connecticut valley. These impressions were discovered soon after the publication of the second edition of the First Report. To the review of that Report we refer our readers for a synopsis of the facts, which were first presented to the public by our author in the "American Journal of Science." It was stated by Professor Hitchcock himself, that his attention was first called to this subject by Dr. James Dean of Greenfield, who forwarded to him a cast of a specimen. Neither at that time, however, nor for some years afterwards, had Dr. Dean given any attention to these relics of the sandstone pedestrians, farther than by rendering aid, in the localities of his vicinity, to our author's extremely laborious researches. In one sense, indeed, the merit of the discovery is his, unless, as is not improbable, it belongs, in the same sense, to some unknown third person. For how many of their discoveries in science have the learned been indebted to the accidental observations of intelligent friends, who, for the want of time, perhaps of scientific information, or even of pecuniary resources, were not able to prosecute the researches, to which they have given the clue! Invariable usage has long since decided, that the merit of a discovery belongs, not to him who may have accidentally found a specimen, but to him who first investigates and makes known its scientific characters and relations. While very great praise is due to Dr. Dean, the honor of the discovery, as a matter of science, must be awarded to our author. Having thus spoken of this gentleman, we add, with pleasure, that his own recent researches on this subject have been rewarded with the discovery of some new species. For several years, the very natural incredulity of geologists and others, in regard to the sandstone tracks, left Professor Hitchcock to bear, with little encouragement, except from his brethren in Europe, the ridicule which the extraordinary announcement occasioned. But now, when a Committee appointed by the American Association of Geologists have, with the most praiseworthy candor, yielded to the force of evidence, and explicitly declared that "the evidence entirely favors the views of Professor Hitchcock," and no one doubts that these impressions are the veritable tracks of animals, it is rather late to say that he is not the discoverer of them.

In his first publication on this subject, seven species of tracks were described, under the name of "Ornithichnites." This name, however, was understood to affirm that the animals were birds. Our author has, therefore, changed the name to "Ornithoidichnites," a sub-order of "Dipodichnites," which embraces seventeen species. Ten species are referred to a new sub-order, "Sauroidichnites." Each of the species is minutely described, and accurately figured. The circumstances of their situation, and all the collateral facts, are narrated, and illustrated with figures. The reader is thus prepared to form an independent judgment respecting the following conclusions.

> "In the first place, these impressions are the tracks of animals, made while the materials composing the rock were in a yielding state.
>
> "In the second place, these tracks were probably made upon the margin of an estuary or lake, where the waters experienced considerable changes of level; with intervals; and in a climate subject to the alternations of wet and dry seasons.
>
> "In the third place, most of the tracks that have been described were made by bipeds.
>
> "In the fourth place, I infer that most of the tracks that have been described were made by birds." — p. 508-510.

The writer sustains these positions by a great variety of cogent arguments. In presenting a garbled statement of them, we should only do him injustice, and we must refer our readers to the work itself.

The geologist finds himself greatly perplexed by the position of the limestone of Berkshire county, and of the adjacent formations, where the older strata appear to lie upon those which are more recent. This inverted position occurs between the Green Mountains and Lake Champlain, and extends as far as Canada; and it seems probable, from the Reports on the Geology of other States, that it extends in the opposite direction into those States. Several hypotheses to account for this extraordinary inversion are examined and rejected.

> "The only remaining theory is, that these rocks have actually been thrown over into an inverted position; or rather have been so contorted by a force acting laterally, that one or more folded axes have been produced. This theory I did, indeed, mention in my Report of 1835; but it then appeared to me too improbable to be admitted. Subsequent reflection and examination have led me to view it in a much more favorable light."—p. 577.

We can give but a very imperfect synopsis of the argument. In the first place, it is shown, by a particular application of this theory to the position of the several formations, illustrated by figures, that it would satisfactorily account for their inversion. In the second place, it explains why the strata of the valleys generally have a less dip, and are more irregular in their dip, than the strata on the mountains. Thirdly, thermal springs and the *dolomitization* of the limestone render it probable that there are extensive fractures in the direction of the strata. It is generally conceded, that similar disturbances have taken place on a small scale; and, finally, Beaumont's theory, of the plication of the crust of the earth in consequence of the contraction of its heated, but cooling, nucleus, presents an adequate force. The difficulty, however, of conceiving such an immense and terrific convulsion, reaching from Hoosac mountain to the Hudson river, without reference to its extent from Canada to Tennessee, is fully admitted by our author. "I confess," he says, "that my mind has staggered under the mighty thought, and I have involuntarily exclaimed, that such a work could have been performed only by Him 'who meted out heaven with a span, and comprehended the dust of the earth in a measure, and weighed the mountains in scales, and the hills in a balance.' "

In close connexion with this theory of inversion is that of the *dolomitization* of much of the limestone of Berkshire county. It has been found in other countries, that, when carbonate of lime is in contact with some unstratified rocks, or is in the vicinity of dislocated strata, it is impregnated with magnesia, or, in other words, it has been converted into Dolomite. The change is supposed to have taken place while the limestone was in a state of fusion, or, at least, softened by heat, and permeable to the gaseous sublimation of carbonate of magnesia. After describing the Dolomite of Berkshire, and the evidences of its change from the original limestone, our author observes ; " Such are some of the marks of the powerful action of internal heat upon the rocks of Berkshire county. To the geologist and chemist they are as striking and convincing, almost, as the lava and smoke of Vesuvius are to the common observer. But, though this agency must have been powerful, when vast masses of limestone were melted and converted into Dolomite, and huge masses of slate impregnated with carbon, yet the only agency now exerted by these almost smothered solfataras is, to raise a few degrees the temperature of two or three springs."

Part Fourth consists of an abridgment of the "Elementary Geology," of which we have noticed a first and a second edition on former occasions. We have now the pleasure of announcing a third edition. The very short period, in which the second was exhausted, is sufficient evidence that our commendation is quite unnecessary.